



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
& ANSI/NCSL Z540-1-1994

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CALIBRATION

Valid To: May 31, 2025

Certificate Number: 0839.03

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 8}:

I. Dimensional

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments ⁵
Length, diameter, thickness	0.01 to 5 mm	6.5 µm	Mitutoyo 123-113 micrometer
	5 to 10 mm	6.6 µm	
	10 to 15 mm	6.7 µm	
	15 to 20 mm	6.9 µm	
	20 to 25 mm	7.1 µm	
Length	1 to 300 mm	0.08 mm	Mitutoyo 530-119 caliper
	3 to 500 mm	0.13 mm	Mitutoyo 534-108 caliper
	500 to 1000 mm	0.16 mm	
Length	0.1 to 1 m	1.0 mm	Stanley 33-443 ruler
	1 to 3 m	1.8 mm	
	3 to 5 m	2.7 mm	
	5 to 8 m	4.1 mm	
	8 to 10 m	5.0 mm	

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 7} ($\pm$)	Comments ⁵
DC Voltage – Generate	0.01 mV to 1 V (1.0 to 10) V (10.0 to 100) V (100.0 to 1000) V	16 μ V/V + 0.64 μ V 16 μ V/V + 2.7 μ V 16 μ V/V + 50 μ V 16 μ V/V + 15 mV	Wavetek 9000 calibrator & Agilent 3458A
DC Voltage – Measure	0.01 mV to 1 V (1.0 to 10) V (10.0 to 100) V (100.0 to 1000) V	16 μ V/V + 0.37 μ V 16 μ V/V + 0.90 μ V 16 μ V/V + 38 μ V 16 μ V/V + 14 mV	Agilent 3458A
DC Current – Generate	(0.01 to 1.0) μ A (1.0 to 10.0) μ A (10.0 to 100) μ A 100.0 μ A to 1.0 mA (1.0 to 10.0) mA (10.0 to 100.0) mA 100 mA to 1.0 A	29 μ A/A + 0.7 nA 29 μ A/A + 0.7 nA 29 μ A/A + 1.2 nA 29 μ A/A + 0.0086 μ A 29 μ A/A + 0.078 μ A 46 μ A/A + 0.58 μ A 0.013 % + 13 μ A	Wavetek 9000 calibrator & Agilent 3458A
DC Current – Measure	(1 to 100) nA 100 nA to 1.0 μ A (1.0 to 10.0) μ A (10.0 to 100.0) μ A 100.0 μ A to 1.0 mA (1.0 to 10.0) mA (10.0 to 100.0) mA 100.0 mA to 1.0 A	40 μ A/A + 0.05 nA 29 μ A/A + 0.05 nA 29 μ A/A + 0.12 nA 29 μ A/A + 0.92 nA 29 μ A/A + 0.006 μ A 29 μ A/A + 0.06 μ A 46 μ A/A + 0.6 μ A 0.013 % + 13 μ A	Agilent 3458A
Resistance – Generate	(0.1 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	23 $\mu\Omega/\Omega$ + 0.14 m Ω 23 $\mu\Omega/\Omega$ + 1.3 m Ω 18 $\mu\Omega/\Omega$ + 1.3 m Ω 18 $\mu\Omega/\Omega$ + 13 m Ω 18 $\mu\Omega/\Omega$ + 0.13 Ω 23 $\mu\Omega/\Omega$ + 7.2 Ω 85 $\mu\Omega/\Omega$ + 0.19 k Ω 0.12 % + 2.6 k Ω 1.2 % + 51 k Ω	JJ Instruments R702 Resistor box (up to 1 M Ω), time electronics 8000-decade resistance (up to 90 M Ω), HL 4084 resistor set (up to 1 G Ω) & Agilent 3458A

Parameter/Equipment	Range	CMC ^{2, 4, 7} ($\pm$)	Comments ⁵
Resistance – Measure	(0.001 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	23 $\mu\Omega/\Omega$ + 0.14 m Ω 23 $\mu\Omega/\Omega$ + 1.3 m Ω 18 $\mu\Omega/\Omega$ + 1.3 m Ω 18 $\mu\Omega/\Omega$ + 13 m Ω 18 $\mu\Omega/\Omega$ + 0.13 Ω 23 $\mu\Omega/\Omega$ + 7.2 Ω 85 $\mu\Omega/\Omega$ + 0.19 k Ω 0.12 % + 2.6 k Ω 1.2 % + 51 k Ω	Agilent 3458A 4-wire method

Parameter/Range	Frequency	CMC ^{2, 4, 7} ($\pm$)	Comments ⁵
AC Voltage – Generate			
(1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V	(1 to 40) Hz	0.034 % + 0.004 mV 0.008 % + 0.006 mV 0.008 % + 0.05 mV 0.008 % + 0.46 mV 0.023 % + 4.6 mV	Wavetek 9000 calibrator & Agilent 3458A
(1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V	(1 to 40) Hz	0.034 % + 0.004 mV 0.008 % + 0.006 mV 0.008 % + 0.05 mV 0.008 % + 0.46 mV 0.023 % + 4.6 mV	
(1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 700) V	40 Hz to 1 kHz	0.023 % + 1.3 μ V 0.008 % + 2.8 μ V 0.008 % + 31 μ V 0.008 % + 0.28 mV 0.023 % + 2.7 mV 0.045 % + 19 mV	
(1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 700) V	(1 to 20) kHz	0.034 % + 1.3 μ V 0.016 % + 2.8 μ V 0.016 % + 3.1 μ V 0.016 % + 0.28 mV 0.023 % + 2.7 mV 0.068 % + 19 mV	
(1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V	(20 to 50) kHz	0.12 % + 1.4 μ V 0.034 % + 3.3 μ V 0.034 % + 23 μ V 0.034 % + 0.23 mV 0.040 % + 2.4 mV	

Parameter/Range	Frequency	CMC ^{2, 4, 7} ($\pm$)	Comments ⁵
AC Voltage – Generate (cont)			
(1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V	(50 to 100) kHz	0.57 % + 1.5 μ V 0.092 % + 3.4 μ V 0.092 % + 24 μ V 0.092 % + 0.25 mV 0.14 % + 2.9 mV	Wavetek 9000 calibrator & Agilent 3458A
AC Voltage – Measure			
(1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 700) V	(1 to 40) Hz	0.034 % + 0.003 mV 0.008 % + 0.005 mV 0.008 % + 0.046 mV 0.008 % + 0.45 mV 0.023 % + 4.5 mV 0.045 % + 45 mV	Agilent 3458A
(1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V	40 Hz to 1 kHz	0.023 % + 2.0 μ V 0.008 % + 2.8 μ V 0.008 % + 23 μ V 0.008 % + 0.23 mV	
(10 to 100) V (100 to 700) V	40 Hz to 1 kHz	0.023 % + 2.3 mV 0.045 % + 16 mV	
(1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 700) V	(1 to 20) kHz	0.034 % + 2.0 μ V 0.016 % + 2.8 μ V 0.016 % + 23 μ V 0.016 % + 0.23 mV 0.023 % + 2.3 mV 0.068 % + 16 mV	
(1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 700) V	(20 to 50) kHz	0.12 % + 1.3 μ V 0.034 % + 2.6 μ V 0.034 % + 23 μ V 0.034 % + 0.23 mV 0.040 % + 2.3 mV 0.14 % + 16 mV	
(1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 700) V	(50 to 100) kHz	0.57 % + 1.5 μ V 0.091 % + 2.9 μ V 0.091 % + 24 μ V 0.091 % + 0.24 mV 0.14 % + 2.4 mV 0.34 % + 17 mV	

Parameter/Range	Frequency	CMC ^{2, 4, 7} ($\pm$)	Comments ⁵
AC Current – Generate			
(10 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(10 to 20) Hz	0.46 % + 0.034 μ A 0.46 % + 0.23 μ A 0.46 % + 2.3 μ A 0.46 % + 23 μ A 0.46 % + 0.23 mA	Wavetek 9000 Calibrator, Wavetek 174 & Agilent 3458A
(10 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(20 to 45) Hz	0.17 % + 0.034 μ A 0.17 % + 0.23 μ A 0.17 % + 2.3 μ A 0.17 % + 23 μ A 0.18 % + 0.23 mA	
(10 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(45 to 100) Hz	0.068 % + 0.034 μ A 0.068 % + 0.23 μ A 0.068 % + 2.3 μ A 0.068 % + 23 μ A 0.091 % + 0.23 mA	
AC Current – Generate (cont)			
(10 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	100 Hz to 5 kHz	0.068 % + 0.034 μ A 0.035 % + 0.23 μ A 0.035 % + 2.3 μ A 0.035 % + 23 μ A 0.12 % + 0.23 mA	
(0.1 to 1) mA (1 to 10) mA (10 to 100) mA	(5 to 20) kHz	0.068 % + 0.23 μ A 0.068 % + 2.3 μ A 0.068 % + 23 μ A	
(0.1 to 1) A	(5 to 10) kHz	0.34 % + 0.23 mA	
(0.1 to 1) mA (1 to 10) mA (10 to 100) mA	(20 to 50) kHz	0.46 % + 0.45 μ A 0.46 % + 4.5 μ A 0.46 % + 45 μ A	
(0.1 to 1) mA (1 to 10) mA (10 to 100) mA	(50 to 100) kHz	0.63 % + 1.7 μ A 0.63 % + 17 μ A 0.63 % + 0.17 mA	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments ⁵
AC Current – Measure			
(10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(10 to 20) Hz	0.46 % + 0.034 µA 0.46 % + 0.23 µA 0.46 % + 2.3 µA 0.46 % + 23 µA 0.46 % + 0.23 mA	Agilent 3458A
(10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(20 to 45) Hz	0.17 % + 0.034 µA 0.17 % + 0.23 µA 0.17 % + 2.3 µA 0.17 % + 23 µA 0.18 % + 0.23 mA	
(10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(45 to 100) Hz	0.068 % + 0.034 µA 0.068 % + 0.23 µA 0.068 % + 2.3 µA 0.068 % + 23 µA 0.091 % + 0.23 mA	
(10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	100 Hz to 5 kHz	0.068 % + 0.034 µA 0.035 % + 0.23 µA 0.035 % + 2.3 µA 0.035 % + 23 µA 0.12 % + 0.23 mA	
(0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(5 to 20) kHz	0.068 % + 0.23 µA 0.068 % + 2.3 µA 0.068 % + 23 µA 0.34 % + 0.23 mA	
(0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(20 to 50) kHz	0.46 % + 0.45 µA 0.46 % + 4.5 µA 0.46 % + 45 µA 1.2 % + 0.45 mA	
(0.1 to 1) mA (1 to 10) mA (10 to 100) mA	(50 to 100) kHz	0.63 % + 1.7 µA 0.63 % + 17 µA 0.63 % + 0.17 mA	
AC High Current – Measure			
(1 to 10) A	40 to 1000 Hz	0.071 %	Agilent 3458A & current shunts
(10 to 30) A	40 to 400 Hz	0.14 %	
(30 to 50) A		0.15 %	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments ⁵
AC High Current – Generate			
(1 to 2) A (2 to 30) A	40 to 400 Hz	0.058 % 0.12 %	Meatest M142
(30 to 600) A		0.36 %	Meatest M142 & current coils

Parameter	Range	CMC ^{2, 4, 7} (±)	Comments ⁵
DC High Current – Generate	(1 to 2) A (2 to 30) A (30 to 600) A	0.018 % 0.026 % 0.34 %	Meatest M142 Meatest M142 & current coils
DC High Current – Measure	(1 to 10) A (10 to 30) A (30 to 50) A	0.040 % 0.049 % 0.077 %	Agilent 3458A & current shunts
DC High Voltage – Measure	(1 to 2) kV (2 to 3) kV (3 to 4) kV (4 to 5) kV (5 to 6) kV (6 to 7) kV (7 to 8) kV (8 to 9) kV (9 to 10) kV	0.04 % 0.05 % 0.07 % 0.09 % 0.12 % 0.14 % 0.16 % 0.18 % 0.21 %	Tektronix P6015A, Agilent 3458A, Wavetek 9000, Associated Research 3670

III. Electrical – RF/Microwave

Parameter/Equipment	Frequency	CMC ^{2, 5} ($\pm$)	Comments ⁵
Biconical Antenna – 3 m 10 m Antenna Factor, (Horizontal Polarization)	(30 to 300) MHz (30 to 300) MHz	1.5 dB 1.5 dB	ANSI C63.5-1998 (SSM) ANSI C63.5-1998 (SSM) ANSI C63.5-2006, excluding Appendix H (RAM)
Log Periodic Antenna – 3 m 10 m Antenna Factor, (Horizontal Polarization)	(200 to 3000) MHz (200 to 1000) MHz	1.5 dB 1.5 dB	ANSI C63.5-1998 (SSM) ANSI C63.5-1998 (SSM) ANSI C63.5-2006, excluding Appendix H (RAM)
Dipole Antenna – 3 m 10 m Antenna Factor, (Horizontal Polarization)	(30 to 1000) MHz (30 to 1000) MHz	1.5 dB 1.5 dB	ANSI C63.5-1998 (SSM) ANSI C63.5-1998 (SSM) ANSI C63.5-2006 (RAM)
Hybrid Broadband Antenna – 3 m 10 m Antenna Factor, (Horizontal Polarization)	(30 to 3000) MHz (30 to 1000) MHz	1.5 dB 1.5 dB	ANSI C63.5-1998 (SSM) ANSI C63.5-1998 (SSM) ANSI C63.5-2006, excluding Appendix H (RAM)

Parameter/Equipment	Frequency	CMC ^{2, 5} (±)	Comments
Horn Antennas – 1 m, 3 m Antenna Factor, (Horizontal & Vertical Polarization)	(1 to 18) GHz (18 to 40) GHz	0.7 dB 1.1 dB	SAE ARP 958D, ANSI C63.5-2017(SSM) Agilent E4407B, E4446A, Rohde & Schwarz NRP- Z91, NRP-Z31, NRP-Z56
Linear Polarized Broadband Antennas – 1 m Antenna Factor, (Horizontal & Vertical Polarization)	(20 to 2000) MHz (1 to 18) GHz (18 to 40) GHz	1.2 dB 1.1 dB 1.7 dB	SAE ARP958E Agilent E4407B, E4446A & R&S SMB100A
Log Spiral Antennas – 1 m Antenna Factor	(0.2 to 10) GHz	1.3 dB	SAE ARP958D Agilent E4407B, E4446A & R&S SMB100A
Rod (Monopole) Antennas – Antenna Factor	9 kHz to 30 MHz	0.75 dB	IEEE Std 291-1991, SAE ARP958D, ANSI C63.5-2017 (ECSM), HP 4195A
Loop Antennas – Antenna Factor	20 Hz to 500 kHz 9 kHz to 30 MHz	0.22 dB 0.9 dB	IEEE 1309, IEEE 291-1992 Helmholtz Coil, Agilent E4446A & Pearson 110A IEEE 291-1992 ANSI C63.5-2017 Standard transmitting loop STL-2, HP 4195A, CT-2

Parameter/Equipment	Frequency	CMC ^{2, 5} (±)	Comments
Magnetic Field Probes – 0.5 mG to 3 G	10 Hz to 500 kHz	2.4 %	IEEE 1309, IEEE 291-1992 Helmholtz Coil Fluke A40A & Agilent 3458A or Agilent E4446A & Pearson 110 A
ELF Electric Field Probes – 50 V/m to 5 kV/m	(16 to 300) Hz	1.5 %	IEEE 1308-1994 Parallel Plates
Line Impedance Stabilization Network (LISN) – Impedance Magnitude Impedance Phase Voltage Division Factor Isolation	(0.009 to 40) kHz (40 to 100) kHz (100 to 300) kHz (0.3 to 400) MHz (0.009 to 40) kHz (40 to 100) kHz (100 to 300) kHz (0.3 to 400) MHz (0.009 to 400) MHz (0.009 to 400) MHz	0.60 % 0.71 % 1.2 % 1.9 % 0.41° 0.50° 0.70° 1.1° 0.09 dB 0.70 dB	CISPR 16-1-2 CISPR 25 (2008) ANSI C63.4-2014, Annex E, MIL-STD 461 RTCA/DO-160 MIL-STD 462 ISO 7637-2, ISO 11452-1 HIOKI 3532-50 LCR HiTESTER, HP 4195A, HP41951A, Agilent 85032E
Coupling Decoupling Network (CDN) – Impedance Magnitude Impedance Phase Coupling Factor	(0.1 to 230) MHz (230 to 400) MHz (0.1 to 230) MHz (0.230 to 400) MHz (0.1 to 230) MHz (230 to 400) MHz	1.9 % 2.6 % 1.1° 1.5° 0.45 dB 0.80 dB	IEC 64000-4-6 HP 4195A, & HP41951A, Agilent 85032E

Parameter/Equipment	Frequency	CMC ^{2, 5} (±)	Comments
150 Ω to 50 Ω adapters – Insertion loss	(0.009 to 230) MHz (230 to 400) MHz	0.32 dB 0.60 dB	IEC 64000-4-6 HP 4195A
Impedance stabilization network (ISN) Impedance Magnitude Impedance Phase Coupling Factor Isolation	(0.1 to 230) MHz (230 to 400) MHz (0.1 to 230) MHz (0.230 to 400) MHz (0.1 to 230) MHz (230 to 400) MHz (0.1 to 400) MHz	1.9 % 2.6 % 1.1° 1.5° 0.45 dB 0.80 dB 0.70 dB	CISPR 16-1-2, CISPR 22, CISPR 32 HP 4195A, & HP41951A, Agilent 85032E
Bulk Current Injection Probes – Insertion loss	10 Hz to 500 MHz	0.3 dB + <i>M</i>	MIL STD-461 IEC 61000-4-6 CISPR 16-1-2 RTCS DO-160F Agilent 3458A, HP 4195
Current Probes – Transfer Impedance	10 Hz to 500 MHz 500 MHz to 1 GHz	0.3 dB + <i>M</i> 0.75 dB + <i>M</i>	IEC 61000-4-6 CISPR 16-1-2 Agilent 3458A, HP 4195, Rhode & Schwarz NRP –Z91
Electromagnetic Field Sensors & Probes – Frequency response, Linearity	10 kHz to 200 MHz 250 to 400 MHz 400 MHz to 18 GHz (18 to 40) GHz	0.75 dB 1.8 dB 1.4 dB 1.8 dB	IEEE 1309 TEM-cell CC-103SEX, Anechoic chamber with double ridged wave guide & standard gain horn antennas

Parameter/Equipment	Frequency	CMC ^{2, 3, 5} (±)	Comments
Electrical Pulse – Measure			
Amplitude	Up to 4 kV	2.7 %	LeCroy LC584AL
Transition time, duration	2 ns to 500 ms	3 %	
ESD simulators			
Contact voltage	0.9 to 32 kV	1.2 %	ESD-VERI-V, DVM CTR2, DSOX6002A
Peak current	6.5 to 130 A	3.9 %	
Rise time	0.6 to 1.1 ns	4.0 %	
Discharge current decay (30 to 800 ns)	0.2 to 78 A	5.9 %	
Amplitude modulation – Measure			
100 kHz to 40 GHz	10 to 90%	1.4 %	Agilent E4446A
RF Power – Measure			
0 dBm, 1 mW reference	50 MHz	0.58 % + <i>M</i>	Rohde & Schwarz NRP-Z56
(-20 to 20) dBm (Absolute)	DC to 100 MHz	0.93 % + <i>M</i>	
	(3.2 to 8) GHz	1.3 % + <i>M</i>	
	(8 to 12.4) GHz	1.5 % + <i>M</i>	
	(12.4 to 26.5)	2 % + <i>M</i>	
	(26.5 to 40) GHz	2.4 % + <i>M</i>	
	(40 to 50) GHz	3.3 % + <i>M</i>	Rohde & Schwarz NRP-Z91 & NRP-Z31
(-19 to 1) dBm (Absolute)	9 kHz to 4 GHz	1.5 % + <i>M</i>	
	(4 to 26.5) GHz	2.1 % + <i>M</i>	
	(26.5 to 33) GHz	2.8 % + <i>M</i>	
(-19 to -55, +1 to 20) dBm (Absolute)	9 kHz to 4 GHz	1.5 % + <i>M</i>	Rohde & Schwarz NRP- Z56, Agilent E4446A
	(4 to 26.5) GHz	2.3 % + <i>M</i>	
	(26.5 to 33) GHz	3.2 % + <i>M</i>	
(-90 to -20) dBm (Absolute)	10 Hz to 100 MHz	2.8 % + <i>M</i>	
	(0.1 to 8) GHz	3.3 % + <i>M</i>	
	(8 to 12.4) GHz	5.3 % + <i>M</i>	
	(12.4 to 33) GHz	5.6 % + <i>M</i>	
	(33 to 40) GHz	7.4 % + <i>M</i>	

Parameter/Equipment	Frequency	CMC ^{2, 3, 5} ($\pm$)	Comments
RF Power – Measure (0.01 to 1000) W (0.1 to 500) W (0.1 to 50) W (0.1 to 50) W (0.1 to 2) W (0.1 to 2) W	10 kHz to 100 MHz (0.1 to 2.4) GHz (2.4 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz (26.5 to 40) GHz	1.4 % + <i>M</i> 1.9 % + <i>M</i> 2.1 % + <i>M</i> 3 % + <i>M</i> 4.6 % + <i>M</i> 5.2 % + <i>M</i>	Rohde & Schwarz NRP-Z56, NRP-Z91, & NRP-Z31, directional couplers, attenuators
RF Power – Linearity (relative power) (0 to 30) dB (0 to 60) dB (60 to 70) dB (70 to 120) dB	10 Hz to 40 GHz 10 Hz to 40 GHz 10 Hz to 500 MHz 10 Hz to 500 MHz	0.01 dB 0.02 dB 0.08 dB 0.13 dB	Tabor Electronics WW5062, Rohde & Schwarz SML03, SMB100A, & NRP-Z56 HP 355D, HP 355C

Parameter/Equipment	Frequency	CMC ^{2, 5} (±)	Comments
Harmonics – Measure (generators & spectrum analyzers)	10 Hz to 1500 MHz (1.5 to 3.3) GHz (3.3 to 11) GHz (11 to 18) GHz	0.45 dB 0.64 dB 0.94 dB 1.10 dB	Agilent E4446A
Resolution bandwidth accuracy & selectivity		0.9 %	Rohde & Schwarz SMB-100A, NRP-Z56, Hewlett Packard 355D, HP355C
Frequency readout accuracy	9 kHz to 40 GHz	0.2 µHz/Hz	Rohde & Schwarz SMB-100A / SML3
Frequency marker count accuracy ⁶	9 kHz to 40 GHz	0.6 pHz/Hz	
Frequency span accuracy	9 kHz to 40 GHz	0.35 %	Rohde & Schwarz SMB-100A / SML3, Keysight N5173B
Sweep time accuracy	100 µs to 10 s	0.35 %	Rohde & Schwarz SMB-100A / SML3, Tabor Electronics WW5062
Residual FM	Up to 350 Hz	10 %	
Third order intermodulation distortion (TOI)	1 MHz to 40 GHz	0.59 dB	Rohde & Schwarz SMB-100A, Keysight N5173B
Gain compression	1 MHz to 40 GHz	0.06 dB	
Display average noise level	10 Hz to 40 GHz	0.29 dB	

Parameter/Equipment	Frequency	CMC ^{2, 3, 4, 5, 7} ($\pm$)	Comments
Harmonics – Measure (generators & spectrum analyzers) cont. -			
Noise Sidebands (Phase Noise)	10 MHz to 3 GHz	0.6 dB	Rohde & Schwarz SMB-100A
System-related sidebands	1 MHz to 40 GHz	0.6 dB	
Input-related spurious responses	1 MHz to 40 GHz	0.6 dB	
Residual response	1 MHz to 40 GHz	0.6 dB	
Resolution bandwidth switching uncertainty	1 Hz to 80 MHz RBW	0.29 dB	
Input attenuator switching uncertainty	(0 to 69) dB (69 to 90) dB (1 to 1000) MHz input signal	0.08 dB 0.13 dB	Rohde & Schwarz SMJ 100A, Hewlett Packard 355D, HP355C
Reference level accuracy	(0 to -69) dB (-69 to -90) dB (1 to 1000) MHz input signal	0.08 dB 0.13 dB	
CISPR detectors response to pulses (pulse generator)	Band A Band B Band C/D	0.30 dB 0.50 dB 0.60 dB	Schwarzbeck IGUU 2918
CISPR detectors response to pulses (pulse modulated carrier)	9 kHz to 1 GHz 1 GHz to 18 GHz	0.16 dB 0.26 dB	Keysight N5173B
CISPR detectors response intermittent disturbance	9 kHz to 18 GHz	0.14 dB	Keysight N5173B

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} ($\pm$)	Comments
RF Power – Generate			
(-25 to 20) dBm	10 Hz to 100 MHz (0.1 to 2.4) GHz (2.4 to 8) GHz (8 to 12) GHz (12 to 18) GHz (18 to 26.5) GHz (26.5 to 40) GHz	0.97 % + <i>M</i> 1.3 % + <i>M</i> 2 % + <i>M</i> 2.9 % + <i>M</i> 3.7 % + <i>M</i> 4.6 % + <i>M</i> 7.3 % + <i>M</i>	Tabor Electronics WW5062, Rohde & Schwarz SML03, SMB100A, & NRP-Z56
(-55 to 20) dBm	9 kHz to 2.4 GHz (2.4 to 4) GHz (4 to 8) GHz (8 to 26.5) GHz (26.5 to 33) GHz	1.7 % + <i>M</i> 2 % + <i>M</i> 3.8 % + <i>M</i> 5.5 % + <i>M</i> 8.4 % + <i>M</i>	Rohde & Schwarz SML03, SMB100A, NRP-Z91, & NRP-Z31
(-80 to -20) dBm	10 Hz to 100 MHz (0.1 to 2.4) GHz (2.4 to 8) GHz (8 to 12) GHz (12 to 18) GHz (18 to 26.5) GHz (26.5 to 40) GHz	2.8 % + <i>M</i> 3.0 % + <i>M</i> 3.3 % + <i>M</i> 4.0 % + <i>M</i> 4.5 % + <i>M</i> 5.3 % + <i>M</i> 7.8 % + <i>M</i>	Rohde & Schwarz NRP- Z56, Agilent E4446A
(0.01 to 500) W (0.1 to 50) W (0.1 to 50) W (0.1 to 25) W (0.1 to 25) W	10 kHz to 100 MHz (0.1 to 2.4) GHz (2.4 to 4) GHz (4 to 12) GHz (12 to 18) GHz	1.5 % + <i>M</i> 2.1 % + <i>M</i> 2.7 % + <i>M</i> 4.1 % + <i>M</i> 5.5 % + <i>M</i>	Rohde & Schwarz SML03, SMB100A, & NRP-Z56, power amplifiers & directional couplers

Parameter/Equipment	Frequency	CMC ^{2, 3, 4, 5, 7} ($\pm$)	Comments
Transmission – Magnitude (Attenuation / Gain)			
DC to 10 kHz	(0 to 45) dB (45 to 65) dB (65 to 80) dB	0.01 dB + <i>M</i> 0.17 dB + <i>M</i> 0.17 dB + <i>M</i>	Rohde & Schwarz NRP-Z56, Agilent E4446A, 3458A, HP4195A
9 kHz to 100 MHz	(0 to 30) dB (30 to 65) dB (65 to 95) dB	0.02 dB + <i>M</i> 0.07 dB + <i>M</i> 0.17 dB + <i>M</i>	Rohde & Schwarz NRP-Z56, NRP-Z91, & NRP-Z31, Agilent E4446A, HP4195A
(50 & 128) MHz	(65 to 110) dB	0.09 dB + <i>M</i>	
100 MHz to 2.4 GHz	(0 to 30) dB (30 to 65) dB (65 to 95) dB	0.02 dB + <i>M</i> 0.07 dB + <i>M</i> 0.18 dB + <i>M</i>	Rohde & Schwarz NRP-Z56, Agilent E4446A, 3458A, HP4195A
(2.4 to 8) GHz	(0 to 30) dB (30 to 65) dB (65 to 95) dB	0.05 dB + <i>M</i> 0.09 dB + <i>M</i> 0.19 dB + <i>M</i>	Rohde & Schwarz NRP-Z56, NRP-Z91, NRP-Z31, Agilent E4446A, HP4195A
(8 to 18) GHz	(0 to 30) dB (30 to 65) dB (65 to 95) dB	0.04 dB + <i>M</i> 0.1 dB + <i>M</i> 0.27 dB + <i>M</i>	
(18 to 26.5) GHz	(0 to 30) dB (40 to 65) dB (65 to 95) dB	0.1 dB + <i>M</i> 0.19 dB + <i>M</i> 0.35dB + <i>M</i>	
(26.5 to 40) GHz	(0 to 30) dB (30 to 65) dB (65 to 90) dB	0.2 dB + <i>M</i> 0.2 dB + <i>M</i> 0.39 dB + <i>M</i>	

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} ($\pm$)	Comments
Reflection Magnitude –			
(0 to 0.08) lin (0.08 to 0.1) lin (0.1 to 0.15) lin (0.15 to 0.2) lin (0.2 to 0.25) lin (0.3 to 0.4) lin (0.4 to 0.5) lin (0.5 to 0.8) lin (0.8 to 1) lin	(0.01 to 500) MHz	0.01 lin 0.01 lin 0.01 lin 0.01 lin 0.01 lin 0.03 lin 0.04 lin 0.32 lin 0.41 lin	HP 4195, Agilent 86205A, Mini-Circuits ZFDC-10-6, Agilent 85032E Agilent 8720ES, Agilent 85032E Cal Kit & Keysight 85518A Cal Kit
(0 to 0.08) lin (0.08 to 0.1) lin (0.1 to 0.15) lin (0.15 to 0.2) lin (0.2 to 0.25) lin (0.3 to 0.4) lin (0.4 to 0.5) lin (0.5 to 0.8) lin (0.8 to 1) lin	(0.5 to 2) GHz	0.01 lin 0.01 lin 0.01 lin 0.01 lin 0.02 lin 0.03 lin 0.05 lin 0.33 lin 0.43 lin	
(0 to 0.08) lin (0.08 to 0.1) lin (0.1 to 0.15) lin (0.15 to 0.2) lin (0.2 to 0.25) lin (0.3 to 0.4) lin (0.4 to 0.5) lin (0.5 to 0.8) lin (0.8 to 1) lin	(2 to 3) GHz	0.01 lin 0.01 lin 0.010 lin 0.02 lin 0.02 lin 0.06 lin 0.09 lin 0.38 lin 0.52 lin	
(0 to 0.08) lin (0.08 to 0.1) lin (0.1 to 0.15) lin (0.15 to 0.2) lin (0.2 to 0.25) lin (0.3 to 0.4) lin (0.4 to 0.5) lin (0.5 to 0.8) lin (0.8 to 1) lin	(3 to 6) GHz	0.01 lin 0.01 lin 0.01 lin 0.02 lin 0.03 lin 0.06 lin 0.09 lin 0.38 lin 0.52 lin	
(0 to 0.08) lin (0.08 to 0.1) lin (0.1 to 0.15) lin (0.15 to 0.2) lin (0.2 to 0.25) lin (0.3 to 0.4) lin (0.4 to 0.5) lin	(6 to 9) GHz	0.03 lin 0.03 lin 0.03 lin 0.03 lin 0.04 lin 0.08 lin 0.11 lin	

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} ($\pm$)	Comments
Reflection Magnitude – (cont) (0.5 to 0.8) lin (0.8 to 1) lin (0 to 0.08) lin (0.08 to 0.1) lin (0.1 to 0.15) lin (0.15 to 0.2) lin (0.2 to 0.25) lin (0.3 to 0.4) lin (0.4 to 0.5) lin (0.5 to 0.8) lin (0.8 to 1) lin	(6 to 9) GHz (9 to 18) GHz	0.42 lin 0.58 lin 0.04 lin 0.04 lin 0.04 lin 0.04 lin 0.05 lin 0.08 lin 0.12 lin 0.42 lin 0.58 lin	HP 4195, Agilent 86205A, Mini-Circuits ZFDC-10-6, Agilent 85032E Agilent 8720ES, Agilent 85032E Cal Kit & Keysight 85518A Cal Kit
Impedance – Measure, Magnitude (0.1 to 0.2) Ω (0.2 to 0.3) Ω (0.3 to 0.4) Ω (0.4 to 0.5) Ω (0.5 to 0.6) Ω (0.6 to 0.7) Ω (0.7 to 0.8) Ω (0.8 to 0.9) Ω (0.9 to 1) Ω (1 to 2) Ω (2 to 3) Ω (3 to 4) Ω (4 to 5) Ω (5 to 6) Ω (6 to 7) Ω (7 to 8) Ω (8 to 9) Ω (9 to 10) Ω (10 to 20) Ω (20 to 30) Ω (30 to 40) Ω (40 to 50) Ω (50 to 60) Ω (60 to 70) Ω (70 to 80) Ω (80 to 90) Ω (90 to 100) Ω	100 Hz to 10 kHz	3.3 % 2.9 % 2.6 % 2.2 % 1.9 % 1.5 % 1.2 % 0.88 % 0.61 % 0.47 % 0.38 % 0.36 % 0.33 % 0.31 % 0.29 % 0.27 % 0.25 % 0.24 % 0.24 % 0.22 % 0.2 % 0.18 % 0.16 % 0.14 % 0.12 % 0.11 % 0.10 %	HIOKI 3532-50 LCR HiTESTER

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} (±)	Comments
Impedance – Measure, Magnitude (cont)			
(100 to 200) Ω	100 Hz to 10 kHz	0.10 %	HIOKI 3532-50 LCR HiTESTER
(200 to 300) Ω		0.10 %	
(300 to 400) Ω		0.10 %	
(400 to 500) Ω		0.10 %	
(500 to 600) Ω		0.11 %	
(600 to 700) Ω		0.12 %	
(700 to 800) Ω		0.12 %	
(800 to 900) Ω		0.13 %	
(900 to 1000) Ω		0.14 %	
(1 to 2) kΩ		0.15 %	
(2 to 3) kΩ		0.10 %	
(3 to 4) kΩ		0.10 %	
(4 to 5) kΩ		0.10 %	
(5 to 6) kΩ		0.11 %	
(6 to 7) kΩ		0.12 %	
(7 to 8) kΩ		0.12 %	
(8 to 9) kΩ		0.13 %	
(9 to 10) kΩ		0.14 %	
(10 to 20) kΩ		0.18 %	
(20 to 30) kΩ		0.18 %	
(30 to 40) kΩ		0.18 %	
(40 to 50) kΩ		0.18 %	
(50 to 60) kΩ		0.19 %	
(60 to 70) kΩ		0.19 %	
(70 to 80) kΩ		0.20 %	
(80 to 90) kΩ		0.20 %	
(90 to 100) kΩ		0.21 %	
(100 to 200) kΩ		0.21 %	
(200 to 300) kΩ		0.21 %	
(300 to 400) kΩ		0.23 %	
(400 to 500) kΩ		0.27 %	
(500 to 600) kΩ		0.32 %	
(600 to 700) kΩ		0.36 %	
(700 to 800) kΩ		0.42 %	
(800 to 900) kΩ		0.47 %	
(900 to 1000) kΩ		0.57 %	
(1 to 2) MΩ		0.58 %	
(2 to 3) MΩ		0.55 %	
(3 to 4) MΩ		0.70 %	
(4 to 5) MΩ		0.88 %	
(5 to 6) MΩ		1.1 %	
(6 to 7) MΩ		1.3 %	

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} (±)	Comments
Impedance – Measure, Magnitude (cont)			
(7 to 8) MΩ	(10.01 to 100) kHz	1.5 %	HIOKI 3532-50 LCR HiTESTER
(8 to 9) MΩ		1.8 %	
(9 to 10) MΩ		2.3 %	
(1 to 2) Ω		0.47 %	
(2 to 3) Ω		0.38 %	
(3 to 4) Ω		0.36 %	
(4 to 5) Ω		0.33 %	
(5 to 6) Ω		0.31 %	
(6 to 7) Ω		0.29 %	
(7 to 8) Ω		0.27 %	
(8 to 9) Ω		0.25 %	
(9 to 10) Ω		0.24 %	
(10 to 20) Ω		0.24 %	
(20 to 30) Ω		0.31 %	
(30 to 40) Ω		0.30 %	
(40 to 50) Ω		0.29 %	
(50 to 60) Ω		0.27 %	
(60 to 70) Ω		0.26 %	
(70 to 80) Ω		0.25 %	
(80 to 90) Ω		0.25 %	
(90 to 100) Ω		0.24 %	
(100 to 200) Ω		0.24 %	
(200 to 300) Ω		0.24 %	
(300 to 400) Ω		0.25 %	
(400 to 500) Ω		0.25 %	
(500 to 600) Ω		0.26 %	
(600 to 700) Ω		0.27 %	
(700 to 800) Ω		0.29 %	
(800 to 900) Ω		0.30 %	
(900 to 1000) Ω		0.31 %	
(1 to 2) kΩ		0.33 %	
(2 to 3) kΩ		0.24 %	
(3 to 4) kΩ		0.25 %	
(4 to 5) kΩ		0.25 %	
(5 to 6) kΩ		0.26 %	
(6 to 7) kΩ		0.27 %	
(7 to 8) kΩ		0.29 %	
(8 to 9) kΩ		0.3 %	
(9 to 10) kΩ		0.31 %	
(10 to 20) kΩ		0.33 %	
(20 to 30) kΩ		0.30 %	

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} (±)	Comments
Impedance – Measure, Magnitude (cont)			
(30 to 40) kΩ	100.1 kHz to 1 MHz	0.32 %	HIOKI 3532-50 LCR HiTESTER
(40 to 50) kΩ		0.34 %	
(50 to 60) kΩ		0.36 %	
(60 to 70) kΩ		0.39 %	
(70 to 80) kΩ		0.43 %	
(80 to 90) kΩ		0.46 %	
(90 to 100) kΩ		0.54 %	
(100 to 200) kΩ		0.54 %	
(200 to 300) kΩ		0.38 %	
(300 to 400) kΩ		0.42 %	
(400 to 500) kΩ		0.48 %	
(500 to 600) kΩ		0.54 %	
(600 to 700) kΩ		0.62 %	
(700 to 800) kΩ		0.7 %	
(800 to 900) kΩ		0.78 %	
(900 to 1000) kΩ		0.95 %	
(1 to 2) Ω		1.2 %	
(2 to 3) Ω		1.1 %	
(3 to 4) Ω		0.99 %	
(4 to 5) Ω		0.88 %	
(5 to 6) Ω		0.79 %	
(6 to 7) Ω		0.69 %	
(7 to 8) Ω		0.61 %	
(8 to 9) Ω		0.55 %	
(9 to 10) Ω		0.50 %	
(10 to 20) Ω		0.47 %	
(20 to 30) Ω		0.47 %	
(30 to 40) Ω		0.45 %	
(40 to 50) Ω		0.43 %	
(50 to 60) Ω		0.41 %	
(60 to 70) Ω		0.39 %	
(70 to 80) Ω		0.38 %	
(80 to 90) Ω		0.37 %	
(90 to 100) Ω		0.36 %	
(100 to 200) Ω		0.35 %	
(200 to 300) Ω		0.36 %	
(300 to 400) Ω		0.37 %	
(400 to 500) Ω		0.38 %	
(500 to 600) Ω		0.39 %	
(600 to 700) Ω		0.41 %	
(700 to 800) Ω		0.43 %	
(800 to 900) Ω		0.45 %	
(900 to 1000) Ω		0.47 %	

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} (±)	Comments
Impedance – Measure, Magnitude (cont)			
(1 to 2) kΩ (2 to 3) kΩ (3 to 4) kΩ (4 to 5) kΩ (5 to 6) kΩ (6 to 7) kΩ (7 to 8) kΩ (8 to 9) kΩ (9 to 10) kΩ	100 kHz to 300 kHz	0.50 % 0.36 % 0.37 % 0.38 % 0.39 % 0.41 % 0.43 % 0.45 % 0.47 %	HIOKI 3532-50 LCR HiTESTER
(10 to 20) kΩ (20 to 30) kΩ (30 to 40) kΩ (40 to 50) kΩ (50 to 60) kΩ (60 to 70) kΩ (70 to 80) kΩ (80 to 90) kΩ (90 to 100) kΩ	0.3 MHz to 1 MHz	0.50 % 0.62 % 0.88 % 1.2 % 1.5 % 1.9 % 2.2 % 2.6 % 3.3 %	
(5 to 250) Ω (250 to 600) Ω (600 to 1000) Ω (1000 to 1600) Ω (1600 to 2000) Ω	1 MHz to 10 MHz	3.5 % 3.7 % 4.2 % 5.0 % 5.7 %	
(5 to 400) Ω (400 to 700) Ω (700 to 1000) Ω (1000 to 1600) Ω (1600 to 2000) Ω	10 MHz to 30 MHz	1.9 % 2.0 % 2.2 % 2.6 % 2.9 %	
(5 to 700) Ω (700 to 1000) Ω (1000 to 1600) Ω (1600 to 2000) Ω	30 MHz to 110 MHz	1.9 % 2.0 % 2.1 % 2.3 %	
(5 to 700) Ω (700 to 1000) Ω (1000 to 1600) Ω (1600 to 2000) Ω	110 MHz to 230 MHz	2.0 % 2.0 % 2.3 % 2.4 %	
(5 to 600) Ω (600 to 1200) Ω (1200 to 2000) Ω	230 MHz to 500 MHz	2 % 2.3 % 3.3 %	
			HP 4195A, HP 41951, Agilent 85032E

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} (±)	Comments
Impedance – Measure, Magnitude (cont)			
(5 to 150) Ω (150 to 600) Ω (600 to 1200) Ω (1200 to 2000) Ω	230 MHz to 500 MHz	1.9 % 2.3 % 2.9 % 4.8 %	HP 4195A, HP 41951, Agilent 85032E
(5 to 150) Ω (150 to 600) Ω (600 to 1200) Ω (1200 to 2000) Ω		2 % 3.1 % 4.5 % 8.5 %	
Impedance – Measure, Phase			
(0 to ± 180) $^{\circ}$			
(0.1 to 0.2) Ω (0.2 to 0.3) Ω (0.3 to 0.4) Ω (0.4 to 0.5) Ω (0.5 to 0.6) Ω (0.6 to 0.7) Ω (0.7 to 0.8) Ω (0.8 to 0.9) Ω (0.9 to 1) Ω	100 Hz to 10 kHz	2.2 $^{\circ}$ 1.9 $^{\circ}$ 1.7 $^{\circ}$ 1.5 $^{\circ}$ 1.2 $^{\circ}$ 1.0 $^{\circ}$ 0.79 $^{\circ}$ 0.58 $^{\circ}$ 0.39 $^{\circ}$	HIOKI 3532-50 LCR HiTESTER
(1 to 2) Ω (2 to 3) Ω (3 to 4) Ω (4 to 5) Ω (5 to 6) Ω (6 to 7) Ω (7 to 8) Ω (8 to 9) Ω (9 to 10) Ω		0.30 $^{\circ}$ 0.27 $^{\circ}$ 0.25 $^{\circ}$ 0.24 $^{\circ}$ 0.22 $^{\circ}$ 0.21 $^{\circ}$ 0.20 $^{\circ}$ 0.19 $^{\circ}$ 0.18 $^{\circ}$	
(10 to 20) Ω (20 to 30) Ω (30 to 40) Ω (40 to 50) Ω (50 to 60) Ω (60 to 70) Ω (70 to 80) Ω (80 to 90) Ω (90 to 100) Ω		0.18 $^{\circ}$ 0.12 $^{\circ}$ 0.11 $^{\circ}$ 0.10 $^{\circ}$ 0.09 $^{\circ}$ 0.08 $^{\circ}$ 0.07 $^{\circ}$ 0.07 $^{\circ}$ 0.06 $^{\circ}$	

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} (±)	Comments
Impedance – Measure, Phase (cont)			
(100 to 200) Ω	100 Hz to 10 kHz	0.06 °	HIOKI 3532-50 LCR HiTESTER
(200 to 300) Ω		0.06 °	
(300 to 400) Ω		0.06 °	
(400 to 500) Ω		0.07 °	
(500 to 600) Ω		0.07 °	
(600 to 700) Ω		0.07 °	
(700 to 800) Ω		0.07 °	
(800 to 900) Ω		0.08 °	
(900 to 1000) Ω		0.08 °	
(1 to 2) kΩ		0.08 °	
(2 to 3) kΩ		0.06 °	
(3 to 4) kΩ		0.06 °	
(4 to 5) kΩ		0.07 °	
(5 to 6) kΩ		0.07 °	
(6 to 7) kΩ		0.07 °	
(7 to 8) kΩ		0.07 °	
(8 to 9) kΩ		0.08 °	
(9 to 10) kΩ		0.08 °	
(10 to 20) kΩ		0.09 °	
(20 to 30) kΩ		0.10 °	
(30 to 40) kΩ		0.10 °	
(40 to 50) kΩ		0.10 °	
(50 to 60) kΩ		0.11 °	
(60 to 70) kΩ		0.12 °	
(70 to 80) kΩ		0.12 °	
(80 to 90) kΩ		0.13 °	
(90 to 100) kΩ		0.15 °	
(100 to 200) kΩ		0.18 °	
(200 to 300) kΩ		0.18 °	
(300 to 400) kΩ		0.19 °	
(400 to 500) kΩ		0.20 °	
(500 to 600) kΩ		0.21 °	
(600 to 700) kΩ		0.22 °	
(700 to 800) kΩ		0.24 °	
(800 to 900) kΩ		0.26 °	
(900 to 1000) kΩ		0.29 °	
(1 to 2) MΩ		0.30 °	
(2 to 3) MΩ		0.33 °	
(3 to 4) MΩ		0.39 °	
(4 to 5) MΩ		0.48 °	
(5 to 6) MΩ		0.58 °	
(6 to 7) MΩ		0.68 °	

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} (±)	Comments
Impedance – Measure, Phase (cont)			
(7 to 8) MΩ (8 to 9) MΩ (9 to 10) MΩ	100 Hz to 10 kHz	0.79 ° 0.90 ° 1.2 °	
(1 to 2) Ω (2 to 3) Ω (3 to 4) Ω (4 to 5) Ω (5 to 6) Ω (6 to 7) Ω (7 to 8) Ω (8 to 9) Ω (9 to 10) Ω	(10.01 to 100) kHz	0.41 ° 0.27 ° 0.25 ° 0.24 ° 0.22 ° 0.21 ° 0.20 ° 0.19 ° 0.18 °	
(10 to 20) Ω (20 to 30) Ω (30 to 40) Ω (40 to 50) Ω (50 to 60) Ω (60 to 70) Ω (70 to 80) Ω (80 to 90) Ω (90 to 100) Ω		0.18 ° 0.22 ° 0.20 ° 0.18 ° 0.16 ° 0.14 ° 0.12 ° 0.11 ° 0.10 °	
(100 to 200) Ω (200 to 300) Ω (300 to 400) Ω (400 to 500) Ω (500 to 600) Ω (600 to 700) Ω (700 to 800) Ω (800 to 900) Ω (900 to 1000) Ω		0.10 ° 0.10 ° 0.11 ° 0.12 ° 0.14 ° 0.16 ° 0.18 ° 0.20 ° 0.22 °	
(1 to 2) kΩ (2 to 3) kΩ (3 to 4) kΩ (4 to 5) kΩ (5 to 6) kΩ (6 to 7) kΩ (7 to 8) kΩ (8 to 9) kΩ (9 to 10) kΩ		0.24 ° 0.10 ° 0.11 ° 0.12 ° 0.14 ° 0.16 ° 0.18 ° 0.20 ° 0.22 °	
(10 to 20) kΩ (20 to 30) kΩ		0.24 ° 0.18 °	

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} (±)	Comments
Impedance – Measure, Phase (cont)			
(30 to 40) kΩ	(10.01 to 100) kHz	0.19 °	
(40 to 50) kΩ		0.20 °	
(50 to 60) kΩ		0.21 °	
(60 to 70) kΩ		0.22 °	
(70 to 80) kΩ		0.24 °	
(80 to 90) kΩ		0.25 °	
(90 to 100) kΩ		0.29 °	
(100 to 200) kΩ		0.35 °	
(200 to 300) kΩ		0.38 °	
(300 to 400) kΩ		0.42 °	
(400 to 500) kΩ		0.47 °	
(500 to 600) kΩ		0.54 °	
(600 to 700) kΩ		0.61 °	
(700 to 800) kΩ		0.69 °	
(800 to 900) kΩ		0.78 °	
(900 to 1000) kΩ		0.95 °	
(1 to 2) Ω	100.1 kHz to 1 MHz	0.66 °	
(2 to 3) Ω		0.61 °	
(3 to 4) Ω		0.57 °	
(4 to 5) Ω		0.52 °	
(5 to 6) Ω		0.48 °	
(6 to 7) Ω		0.44 °	
(7 to 8) Ω		0.41 °	
(8 to 9) Ω		0.38 °	
(9 to 10) Ω		0.36 °	
(10 to 20) Ω		0.35 °	
(20 to 30) Ω		0.27 °	
(30 to 40) Ω		0.25 °	
(40 to 50) Ω		0.24 °	
(50 to 60) Ω		0.22 °	
(60 to 70) Ω		0.21 °	
(70 to 80) Ω		0.20 °	
(80 to 90) Ω		0.19 °	
(90 to 100) Ω		0.18 °	
(100 to 200) Ω		0.18 °	
(200 to 300) Ω		0.18 °	
(300 to 400) Ω		0.19 °	
(400 to 500) Ω		0.20 °	
(500 to 600) Ω		0.21 °	
(600 to 700) Ω		0.22 °	
(700 to 800) Ω		0.24 °	
(800 to 900) Ω		0.25 °	

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} (±)	Comments
Impedance – Measure, Phase (cont)			
(900 to 1000) Ω	100.1 kHz to 1 MHz	0.27 °	
(1 to 2) kΩ		0.29 °	
(2 to 3) kΩ		0.18 °	
(3 to 4) kΩ		0.19 °	
(4 to 5) kΩ		0.20 °	
(5 to 6) kΩ		0.21 °	
(6 to 7) kΩ		0.22 °	
(7 to 8) kΩ		0.24 °	
(8 to 9) kΩ		0.25 °	
(9 to 10) kΩ		0.27 °	
(10 to 20) kΩ		0.35 °	
(20 to 30) kΩ		0.52 °	
(30 to 40) kΩ		0.82 °	
(40 to 50) kΩ		1.2 °	
(50 to 60) kΩ		1.5 °	
(60 to 70) kΩ		1.8 °	
(70 to 80) kΩ		2.2 °	
(80 to 90) kΩ		2.5 °	
(90 to 100) kΩ		3.2 °	
(5 to 250) Ω	100 kHz to 300 kHz	2.0 °	HP4195A, HP41951, Agilent 85032E
(250 to 600) Ω		2.1 °	
(600 to 1000) Ω		2.4 °	
(1000 to 1600) Ω		2.9 °	
(1600 to 2000) Ω		3.3 °	
(5 to 400) Ω	0.3 MHz to 1 MHz	1.1 °	
(400 to 700) Ω		1.2 °	
(700 to 1000) Ω		1.3 °	
(1000 to 1600) Ω		1.5 °	
(1600 to 2000) Ω		1.7 °	
(5 to 700) Ω	1 MHz to 10 MHz	1.1 °	
(700 to 1000) Ω		1.1 °	
(1000 to 1600) Ω		1.2 °	
(1600 to 2000) Ω		1.3 °	
(5 to 700) Ω	10 MHz to 30 MHz	1.1 °	
(700 to 1000) Ω		1.2 °	
(1000 to 1600) Ω		1.3 °	
(1600 to 2000) Ω		1.4 °	

Parameter/Range	Frequency	CMC ^{2, 3, 4, 5, 7} ($\pm$)	Comments
Impedance – Measure, Phase (cont)			
(5 to 600) Ω (600 to 1200) Ω (1200 to 2000) Ω	30 MHz to 110 MHz	1.2 $^\circ$ 1.3 $^\circ$ 1.9 $^\circ$	
(5 to 150) Ω (150 to 600) Ω (600 to 1200) Ω (1200 to 2000) Ω	110 MHz to 230 MHz	1.1 $^\circ$ 1.3 $^\circ$ 1.7 $^\circ$ 2.7 $^\circ$	
(5 to 150) Ω (150 to 600) Ω (600 to 1200) Ω (1200 to 2000) Ω	230 MHz to 500 MHz	1.1 $^\circ$ 1.8 $^\circ$ 2.6 $^\circ$ 4.8 $^\circ$	

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2, 4, 7} ($\pm$)	Comments ⁵
Scales & balances	200 g 1 g 2 g 5 g 10 g 20 g 50 g 100 g 500 g 1 kg 2 kg 5 kg 10 kg	0.38 mg + 0.58R 0.34 mg + 0.58R 0.45 mg + 0.58R 0.57 mg + 0.58R 0.68 mg + 0.58R 0.9 mg + 0.58R 1.1 mg + 0.58R 1.8 mg + 0.58R 9.1 mg + 0.58R 18 mg + 0.58R 34 mg + 0.58R 91 mg + 0.58R 0.18 g + 0.58R	Class F2 weights
Mass measure	0.1 to 200 g 200 to 1500 g 1.5 to 15 kg	7.4 mg 54 mg 1.6 g	Class F2 weights + laboratory balances

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 7} ($\pm$)	Comments ⁵
Relative Humidity, Fixed Points	10 % RH 50 % RH 95 % RH	0.44 % RH 0.85 % RH 1.2 % RH	Calibration kit EM-15, EDM 15/15 Rotronic & Rotronic EA10, EA50 & EA95 humidity standard
Relative Humidity – Measure ⁹	(10 to 95) % RH	2.1 % RH	Rotronic HC2-S & HL- NT2-Dp
Temperature – Measure ⁹	(-80 to 200) °C	0.04 °C	Hart Scientific 5615, 1524
Temperature – Measuring Equipment	(-80 to 100) °C	0.04 °C	Hart Scientific 5615, 1524, 7380 Bath
Temperature Uniformity – Measure ⁹	(-80 to 100) °C	0.7 °C	Fluke 2620A, 2625A, 2625A w/ thermocouple probes

VI. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 7} ($\pm$)	Comments ⁵
Frequency – Measure & Measuring Equipment	10 MHz (1 to 10) Hz (10 to 100) Hz (100 to 1000) Hz (1 to 10) kHz (10 to 100) kHz (0.1 to 10) MHz (10 to 100) MHz (0.1 to 12.8) GHz (12.8 to 40) GHz	6.2 mHz 0.03 % 0.003 % 3.4 μ Hz/Hz 0.36 μ Hz/Hz 0.12 μ Hz/Hz 0.12 μ Hz/Hz 0.01 μ Hz/Hz 0.01 μ Hz/Hz 0.01 μ Hz/Hz	Arbiter System Satellite-controlled Clock 1084B, LeCroy LC584AL, HP5327C, Agilent 4446A, Tabor WW5062, R&S SMB100A

¹ This laboratory offers commercial calibration service only.

² Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

³ In the statement of CMC, M is the Mismatch error due to connections of calibrated device to calibration set up in actual use.

⁴ In the statement of CMC the percentage is defined as percent of reading.

⁵ Laboratory calibrations are to the current revision/configuration of the applicable standard. Calibration to earlier version or revision of the standard can be provided on request.

⁶ The Frequency marker count accuracy utilizes a Synthesized Sweeper that is phase locked to the DUT and the frequency error is eliminated.

⁷ The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.

⁸ This scope meets A2LA's *P112 Flexible Scope Policy*.

⁹ Field calibration service is available for this calibration. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the Calibration and Measurement Capability Uncertainty (CMC) found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.



Accredited Laboratory

A2LA has accredited

HERMON LABORATORIES

Binyamina, Israel

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 12th day of September 2023.

A blue ink signature of Mr. Trace McInturff.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 0839.03
Valid to May 31, 2025

For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.